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Just west of Singapore Island, the Malacca Strait and the South China Sea tides converge, locally retarding the scouring capacity and apparently favouring heavy marine sedimentation derived from the adjoining land masses. Among the Lingga and Rhio Islands, the actual tidal movements are extremely complicated due to convergent tidal waves from neighbouring seas. Tidal values in all these seas are modified seasonally by winds which practically reverse through the year, working to augment or reduce the tides as the case may be. The South China Seas, whose length parallels the direction of the seasonal wind streams, is particularly subject to this modification in the Northeast Monsoon which very much affects the ease of tidal progression from that sea into the Java Sea.

Corals

The polyps and other organisms whose skeletons accumulate to form coral reefs, live in colonies which within four years may grow to two inches in diameter from a single individual. They are exacting in their environmental requirements, needing sea temperatures of at least 58° F. throughout the year, shallow clear water to permit their food processes, which are largely photosynthetic, and fairly high salinity. A live coral colony has a slimy surface which is in fact the living matter; the live cells die if exposed to the air, or if covered with mud. Corals establish themselves for the most part on rocky foundations. Off Southeast Asia distinct differences can be seen in their regional distribution.

On the Sunda Platform as a whole corals are only developed well beyond easy access from the shore. The relatively fresh seas with swampy margins heavily charged with fine silts and humic acids are unfavourable to the polyps and the recent history of slow inundation of the Platform operates against them as well, though corals are found at depth along its margins and in broad belts round the rocky islands off South Malaya. Platform corals are exclusively submarine and generally stand below sea level well offshore, so that they are never prominent on a coastal landscape. The great development of coral is on the eastern edge of the Platform, running parallel to the east coast of Borneo and well out into the Macassar Strait (Fig. 7), where broad reefs occur whose proportions resemble those of the Great Barrier Reef on the eastern edge of the Sahul Shelf. These locations are favourable because they are washed by the warm onshore equatorial currents;

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FIG. 7.—The Borneo Bank and the Great Sunda Barrier Reef on the East of the Sunda Platform

similar extensive developments on the western side of the continental shelf are prevented by slight upwellings of water produced behind offshore currents.

Within the 'mediterranean seas', the occurrences of coral are less extensive at any one point but they show much greater variety of form. Atolls, barriers and reefcaps at varying levels above, below and inclined to present sea levels and in varying degrees of symmetry to existing islands, may be found in this zone where there has been steady and repeated displacement of the geanticlines which form the chains of islands.

Several theories have been devised to account for the formation of coral. All of them start from the environmental requirements of the live polyp, which is eulittoral, and go on to account for the shape and extent of the accumulations of skeletons by some change of water level. In the Southeast Asia seas may be found examples to support those coral formation theories stressing sea level or eustatic change, a dominant process on the Sunda Platform, and also examples of corals associated with secular changes of the earth's crust, the chief physical factor operating among islands of the 'mediterranean seas' and the basis of theories attributing coral formations to submarine tectonic changes.

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water in the Sunda Platform seas today is 180 ft., so that on Daly's figures the whole Platform would be exposed and drainage lines developed upon it. Molengraaf's work (Fig. 18) suggests the drainage lines of the exposed Sunda continental surface formed two river systems flowing roughly north-eastwards from the Singapore area and roughly due east through what is now the Java Sea. To support this conception he instances the striking likeness between fish of the Moesi in Sumatra and those of the Kapuas in Borneo and suggests the similarity derives from association through the main stream developed during the Glacial period. Because there have been in fact several glacial advances in northern latitudes (the Gunz, Mindel, Riss and Wurm Glaciation) his theory implies at least four periods of water withdrawal from the Sunda Platform (and of course from all equatorial areas): that is, four periods when the Sunda sea-floors were exposed to subaerial erosion.

Thus the broad history of recent river development has been one of periodical lowering of sea level, in effect a lowering of erosion base levels for all Sunda Platform rivers, which means four intervening periods of rejuvenation of Southeast Asia rivers and corresponding periods of rising sea level when rivers diminished their cutting power and became senescent, owing to rising erosional base level (Fig. 17). While the world glacial periods varied in duration, they appear not to have differed very widely in extent of greatest development, so that present sea level at the Equator probably represents roughly the level towards which the erosional base rose at each interglacial phase. Those early periods of rising sea could not, on present facts, have reached higher than 100 ft. above present sea level and it is almost certain the variation was much less. It is therefore difficult to accept any theorising which postulates during the last million years over the Sunda Platform sea level positions 100 ft. higher than the present one.

The landscapes carved by river systems over the older parts of Southeast Asia are conditioned in their recent forms by circumstances of a rising sea level, quite different from Europe and North America where a relatively rising land surface has had the latest influence on landscape form. A recent history of rising sea level implies:

(*a*) rising base levels to river erosion;

(*b*) diminution of downcutting power by existing streams;

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trees of Dipterocarp type gradually disappear and temperate trees of the oak and chestnut type become commoner, though the landscape continues full of giant bracken and tree ferns. Higher still the vegetation dwarfs considerably, shadiness diminishes, and woody plants become twisted and gnarled. This often turns into a moss or "elfin" forest above 5,000 ft., in localities where the air is constantly cool and saturated, to produce thick blankets of wet mosses and liverworts upon all other vegetation. Mosses hang in fantastic festoons everywhere and sometimes (as in Borneo) form walls or platforms under which other vegetation, such as dwarf oaks and rhododendrons, are buried (Harrison). Moss forest will not occur in localities with a noticeable dry season: in monsoon areas it is replaced in succession by pine forest, in which, however, some broadleaved trees persist. Above both these mountain forest types (above 6,500 ft.), mountain grasses and shrubs form landscapes of rolling downlike appearance.

Fauna

Between the western and eastern fringes of Southeast Asia there are greater differences zoologically than between Asia and South America, even though these are separated by the Atlantic (Merrill). The differences derive from the long separation of Australia from Asia. Migration has gone on from Asia and Australia into the islands and peninsulas of Southeast Asia which is thus a transitional zoogeographical region (Fig. 24).

The Tropical Rain Forest has complicated ecologies of living creatures associated with the various storeys and the variety of these creatures parallels the variety of vegetation. Large animals such as elephants, tigers, rhinoceros, etc., are relatively few and confined to the coastal sections. Specially numerous are arboreal and flying creatures, butterflies, birds, moths and insects. These are able to migrate from place to place with considerable ease so that the convergence of Asiatic and Australian species has gone on fairly freely. The contrasting zoological types are summed up in the difference between mammals; in Australia, except for a few bats and rodents, mammals are marsupial (pouched) or monotreme (single vented); in Asia these groups are entirely lacking and are replaced by placental mammals, monkeys, shrews, squirrels and ungulates.

By far the richest zoological group is that spreading from Asia.

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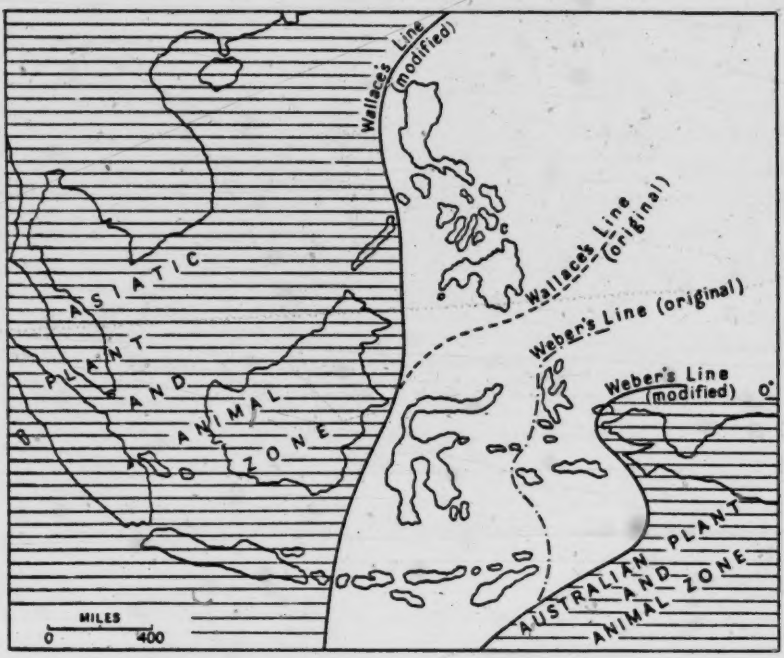

FIG. 24.—Biological Regions of Southeast Asia

136 For a long time Wallace's Line was held to demarcate these zoological types; Wallace himself drew the boundary just west of Lombok and Celebes but Huxley later extended it to include the Philippines in the "Australian" zone. Geographically the boundary clearly correlates with the limits of the Sunda Platform and the interglacial connection between Malaya, Borneo, Sumatra and Java appears to have permitted zoological migration fairly uniformly among them, whereas there has been no continued land connection between the "mediterranean islands" east of the Platform. Later more detailed study of the fauna has produced criticisms of the Wallace Line. The steady pressure of zoological types eastward has been demonstrated and Weber laid down another limit which he showed more closely to accord with the balance between Asiatic and Australian fauna. East of it Australian types dominate. Wallace's Line thus is now best thought of as the eastward limit of the typically Asiatic zoological types; it is matched by a line just west of the Sahul Shelf which is the westward limit of exclusively Australian and New Guinea faunal types.

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Between this and the Wallace Line is the zone of tectonic instability, the "mediterranean" zone, where faunal destruction followed by re-population from nearby continents has gone on fairly frequently, but irregularly and without uniformity from place to place; Weber's Line is roughly marginal to this "mediterranean" faunal zone.

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Chapter Twenty-three

THE FISHERIES OF SOUTHEAST ASIA

The Fish Population

136 Because equatorial waters have low salinity and low oxygen content, it has frequently been assumed that they have a low fish population. That view is difficult to maintain for the shallow waters of Southeast Asia where, according to Herre, the number of kinds of fish and their diversification is unrivalled by that of any other marine region. Whether this paradox disproves the theoretical view about equatorial seas or shows that the fish population depends more on the local supply of nutrients which so broken and well-watered a region as Southeast Asia discharges to the sea in extraordinarily large quantities, has yet to be demonstrated. There is no co-ordinated study of the fishing industry as a whole in this region.

Until recently, only the generic character of these Southeast Asia fish had been studied, from which it appears that, while by no means all of them have been named and identified, over 1,500 varieties are normally fished round Java, over 500 have been named as economically valuable round Malaya, and similar large varieties are reported from all territories. Most of the fish known are inshore fish, closely dependent on food particles carried from shore to sea and on the great growth of plankton, seaweeds and corals which supply fish food. Because the shores of the landmasses in most of this region are frequently backed by swamps, there is a very considerable fish population on the land surface itself, in a gradual transition between shallow water marine fish and swamp or riverine fish. Thus the fishing industry is not merely an inshore activity: it continues very vigorously inland, in the swamps, in the flooded paddyfields and their canals, in the lakes and lagoons, and in the rivers.

Though the deep-water fish of Southeast Asia have only in recent years been exploited commercially, by Japanese trawlers, they exist in these waters in surprising numbers. Schools of sardines some 10 miles long have been seen, together with frequent

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great shoals of mackerel and bonito. Porpoises (mammals which live on fish and are a guide to the fish density) have been seen in a school which packed an area 15 miles long and 2 miles broad. Plankton occurs at times in astounding quantities, practically smothering all other fish life in the neighbourhood. The movements and migrations of these fish of deeper waters have been little studied and the inshore fishing has been enough to meet local food needs, as well as not demanding too complex a technique or too great a capital outlay by the local fishermen who are generally very few, and too poor to equip themselves for long distance deepwater trips. A major impediment to introducing the elaborate systems of trawling and seining which have been developed in temperate seas is the frequency of coral reefs and knolls which, although attracting fish, catch the nets and ruin them.

Fish as a Staple Food

Fish is a staple in the Southeast Asia diet as complement to rice. It supplies calcium, iodine and salt as well as animal protein, items otherwise not easily come by in these areas, or too expensive for the peasants. By habit Southeast Asia people are rice-fish-curry eaters and vegetables in the European sense enter very little into their meals. They are largely vegetarian but not interested in vegetables. Fishing has an importance in local ecologies second only to rice. In Malaya, for example, well over 80 lbs. of fish is normally consumed by every man, woman and child every year. When looking through the records of any one territory, however, the great significance of fish is not apparent because fishing is a mobile and widely dispersed activity not easily checked, the more illusive statistically because it plays little or no part in revenues.

Several stages of commercialisation are met with but subsistence fishing predominates. In every paddyfield and swamp, villagers go fishing for their personal needs; on the coast many fishermen are part-time, sharing their labour between a paddyfield and a fishing boat. Some villages have specialised fishermen whose produce goes into exchange among the landsmen to make the village self-supporting. Gradually fishing for sale has become possible, yet there are major difficulties of transport to consuming centres, of organisation between fishermen and consumer, and of preserving the fish in good condition during transport.